ADDRESSING THE HUMAN HEALTH IMPACTS OF CLIMATE CHANGE: THE ROLE OF INDIVIDUAL ATTITUDES, PERCEPTIONS, AND BELIEFS IN AGENCY ACTION

Thesis

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ABSTRACT

Despite the scientific consensus that global climate change is currently underway, public health agencies in the United States fail to exemplify the practice of preparedness in anticipation of the negative impacts a changing climate will have on human health. It is critical to identify why public health agencies are not taking action so as to identify how to engage them in preparing the public for the most relevant health risks. Individual decisions based on values and personal beliefs rather than on scientific evidence might help explain why critical mitigation and adaptation measures are not in place to address the predicted health impacts of climate change. To that end, we surveyed Nursing Directors around the United States to determine how their individual attitudes, perceptions, beliefs, and knowledge about climate change and its related health impacts might help explain agency responses, or failures to respond, to such health risks.

It was expected that female Nursing Directors with a positive environmental attitude and a liberal political ideology would have more positive attitudes toward taking action and higher perceptions of risk, responsibility, and control in relation to climate change and human health. The results of this study indicate that despite positive attitudes toward taking action, most departments do not have any programs in place and Nursing Directors often do not feel a personal sense of responsibility or departmental ability to take action. Environmental attitude, political ideology, risk perception, and perceived levels of control and responsibility each made unique contributions in explaining the variation in Nursing Directors' attitudes towards action. Programs that provide information about the relevant health impacts, as well as work to increase individual directors' sense of responsibility and risk and that are sensitive to political

ideology may help motivate attitudes and behaviors conducive to taking action and increased public health preparedness.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: CLIMATE CHANGE BACKGROUND AND PREDICTED HEALTH IMPACTS

1.1 **Introduction and Purpose of Study**

Despite the growing scientific consensus that global climate change is happening and bringing with it a comprehensive range of adverse impacts, the United States remains at a standstill in addressing the concerns that promise to affect the health of American people. Behavior and decision research suggests that the public and government's failure to respond is less than shocking because while people generally feel concerned about climate change, there is a lack of perceived imminent or personal threat, and consequently there is also a lack of risk management action (Leiserowitz, 2005; Weber, 2006). Where scientific evidence would seem enough to motivate action towards adaptation and mitigation efforts, research suggests that judgment is not always driven by the empirical facts, and that affect, personal experience, and preexisting values and worldviews can be more powerful in influencing decisions (Slovic, 1987; Weber, 2006; Weber & Stern, 2011). Such behavioral tendencies create an issue from a public health standpoint, because the values and personal beliefs of individual decision-makers within local health departments could potentially inhibit agency action that might address the many human health threats that climate change poses.

The research reported here aims to identify how the beliefs and perceptions of individual decision-makers might influence agency action in an effort to deduce why public agencies in the United States fail to exemplify the practice of preparedness in anticipation of

the negative impacts of climate change on human health. Nursing Directors[1] are one type of public health decision-maker responsible for planning, implementing, and evaluating programs to address public health concerns within their jurisdiction. Nursing Directors around the country were surveyed to determine how his/her individual attitudes, perceptions, beliefs, and knowledge about climate change and the related health impacts might help explain agency responses, or failures to respond, to such health risks. This chapter will first discuss the scientific and historical context of climate change before detailing why climate change is so inextricably linked to the public health sector and what specific health hazards a changing climate is predicted to amplify or create.

1.2 Scientific Evidence and Historical Background

Climate change is the physical phenomena of long-term measureable changes in the Earth's global climate. Today, the mean annual temperature (MAT) of the Earth's surface is 15°C, and based on the evidence provided by paleoclimatology and various proxies like ice and deep ocean core data, tree rings, and historical documents, among others, we know that the MAT has varied naturally over hundreds of thousands of years (EPICA, 2004). For example, paleoclimatologists are able to gauge global temperature changes over time through measurements of greenhouse gases contained in the fossilized sediments trapped in core samples. These "greenhouse" gases in the atmosphere, such as carbon dioxide (CO_2), methane, nitrous oxide, water vapor, and ozone, insulate some of the solar energy Earth receives from

[1] Nurse administrators, managers, supervisors or chiefs, division directors, health identification and surveillance managers, registered nurse administrators, or regional nurses

the sun, and have been responsible for regulating the temperature of our planet since its very beginnings.

The best way to describe Earth's climatic behavior over the past 650,000 years up until the mid-19th century is as a natural and dynamic series of cycles. Slight variations in the Earth's orbit, the tilt on its axis, or tectonic plate movement have caused drops in greenhouse gas concentrations that have thrown the planet into Ice Ages that last tens of thousands of years. The Earth subsequently thawed out during warm, interglacial periods when those gases fluctuated again (Intergovernmental Panel on Climate Change, 2007). These heating and cooling cycles occur on 100,000 year cycles, and during the past 650,000 years concentrations of carbon dioxide in the atmosphere have ranged from 180 parts per million (ppm) during the glacial periods to concentrations of around 300ppm during the 'Hot House' periods (National Oceanic and Atmospheric Administration (NOAA), 2012). Since scientists are able to follow these cycles back 650,000 years and monitor resulting climatic changes, the fact that they are naturally occurring and not wholly attributable to human activity is a fundamental concept that is important to understand before attempting to fathom the issue of climate change that scientists, policymakers, and the public face today.

Climate change emerged as not only a scientific, physical phenomena, but also as a policy issue in the late 1950s when measurements of atmospheric levels of carbon dioxide taken on Mauna Loa, Hawaii showed concentrations of 315ppm, a concentration far above the highest concentration that had ever been recorded in ice core data (300ppm measured from 420,000 years ago) (Weber & Stern, 2011). Scientists continued modeling climates, and the next two decades saw developments in both technology and in knowledge regarding the

complexities of atmospheric sciences and the role of solar radiation and greenhouses gases. By the late 1970s, carbon dioxide concentrations had increased, to 335ppm, as had the emerging fear that human activity was playing a part in the rising concentrations. Following the emergence of this fear came a wave of legislative movements and the creation of an organization called the Intergovernmental Panel on Climate Change (IPCC) that was meant to review research from around the world and publish current findings and suspected implications of climate change, a task it continues to do so today. Since the late 1980s, the IPCC has published four comprehensive assessment reports and held international conventions in an effort to continue to broaden knowledge of climate change's inevitable impacts and how governments around the world might respond.

Today, atmospheric levels of carbon dioxide have reached 392ppm, a 39% increase over pre-industrialization concentrations. The IPCC Fourth Assessment Report (2007) states that this significant and rapid rise in carbon dioxide and other greenhouse gas concentrations is driving most of the observed increases in global temperature averages since the mid-twentieth century and is "very likely" a result of the increase in anthropogenic greenhouse gas emissions.

Therefore, humanity is now faced with the challenge of addressing a climate that is changing in ways outside the bounds of variation of the past half-millennium (McMichael, 2003; Weber and Stern, 2011). Climate change persists as a "hot button" issue that scientists have difficulty communicating, and policymakers and the public have difficulty understanding; the more climate change emerges as a pressing environmental concern, the more obvious it becomes that it is an enormously complex issue comprised of vastly unexplored research territory (Schmidt, 2010). A changing global mean temperature holds large implications from

an ecological standpoint, but this ongoing event is also currently affecting, and promises to continue to affect, the health of human populations.

1.3 Predicted Human Health Impacts

The predominant climate change research that exists today pays a great deal of attention to rising surface temperatures and sea levels, disappearing land and sea ice, retreating glaciers, the warming and acidification of the oceans, and increasing climate extremes and variability and how these things affect global environments. While this research is critical, most of it neglects to focus on the resulting human health impacts, despite evidence that anticipates adverse health consequences (Haines et al., 2006; Frumpkin et al., 2008). The public health sector faces a great challenge in acting to not only respond to predicted health risks, but also in working to close knowledge gaps and appropriately communicate uncertainty about health impacts that are most relevant to specific regions. The health risks detailed below include most of the changing climate's anticipated adverse effects on populations.

1.2.1 Regional and Local Weather Change

While natural and human influences on climate will cause global climate variability and change, from a human health and policy standpoint, regional and local weather changes carry the greatest risks. Extremes in weather occurrences and changes in temperature and precipitation can have devastating impacts on both human health and infrastructure. Predicting the time, location, and intensity of these events and how they will impact populations on a

regional level is extremely difficult, which creates an even greater challenge for strategic planning.

More people in the United States die each year as a result of extreme-heat events than any other severe weather events, and climate models predict that heat waves will increase in both frequency and severity as a result of climate change (IWGCCH, 2010). Populations are at risk for health outcomes such as heat exhaustion, heat cramps, heat stroke, dehydration, acute renal failure, electrolyte disorders, and death. Regional factors, such as population demographics, socioeconomic status, and the existing climate affect the negative impacts a heat wave can have. Further, vulnerable populations such as the elderly, infants, and those with pre-existing health conditions are more at risk for adverse health effects. Those who live in cities are also more at risk to experience heat-related morbidity or mortality because urban areas generally have higher heat indexes than surrounding suburban or rural areas. Therefore, as the United States continues to demonstrate growth in both urbanization and the elderly population, risks associated with heat-related morbidity and mortality are expected to increase in severity (Basu & Samet, 2002).

Beyond just heat waves, long-term epidemiological studies have found a correlation between mortality and exposure to general elevated ambient temperatures; exposed populations are more at risk to suffer from cardiovascular, respiratory, or cerebrovascular diseases or diabetes. As with heat waves, vulnerable sub-groups of the population are at higher risk (Basu, 2009).

Although the occurrence of extreme weather events such as hurricanes, blizzards, floods, or droughts have not been conclusively linked to climate change, these events are

anticipated to increase in intensity and severity. In the past 50-100 years particularly, precipitation events have become more extreme and frequent around the United States, especially the Midwest and the Northeast (IWGCCH, 2010). Increased intensity of weather events poses greater risks not only to populations, but also to the economy through human and infrastructural response and recovery. Hurricane Katrina, for example, certainly impacted human morbidity and mortality in New Orleans and other affected areas, but it also generated estimated recovery costs upwards of $150 billion (Burton & Hicks, 2005). Extreme temperature, precipitation, and weather events have direct and indirect impacts on human morbidity and mortality, and these regional and local changes create variability in other factors, including air quality, water availability and quality, infectious disease prevalence, and agricultural productivity. These remaining impacts are discussed below.

1.2.2 Air Quality

As temperature and precipitation increase, so will the concentration and distribution of both air pollution and aeroallergens. Research shows that warmer temperatures are linked to increases in photochemical smog, which is a mixture of gases and particulate chemicals and is unhealthy for humans to breathe in. Smog is a "secondary pollutant" that forms when harmful emission gases like nitrogen oxides, volatile organic compounds, and sulfur dioxide are released into the air and react with sunlight (Mickley, 2007). Ozone, one of the most harmful components of smog, is not a gas that is directly emitted into the atmosphere, but is a result of reactions that take place between other chemicals like methane and volatile organic compounds. Once breathed in, ozone can damage lung and throat tissue, cause chest pain,

induce coughing and congestion, and can exacerbate existing respiratory illnesses like asthma, emphysema, and bronchitis. As temperatures continue to increase, there is a greater probability that ozone levels could exceed the Environmental Protection Agency's standard of 84 parts per million, tipping the air quality index from "moderate" to "unhealthy," particularly in the summertime (Mickley, 2007).

Particles less than 2.5 micrometers are known to be just as harmful as ozone; these microscopic particles are too small to be caught in a human's upper respiratory tract and are therefore able to work their way into deep lung tissue. Just like ozone, particulate matter can cause or aggravate a number of respiratory problems including asthma and bronchitis and can also cause heart problems (Mickley et al., 2004; Mickley, 2007; IWGCCH, 2010).

Further, as temperatures and humidity rise in some regions, the increased production of aeroallergens like pollen and mold are expected to pose increased risk to air quality and human respiratory health. Higher levels of carbon dioxide in the atmosphere are expected to lengthen the pollen season, and allergens like mold spores that flourish in moist environments will benefit from more precipitation (Ziska & Knowlton, 2011). Once more, the increased presence of aeroallergens is expected to directly cause the incidence of respiratory illnesses or to worsen those that individuals already have.

Rising emission levels affect the concentrations of air pollution, which in turn affect the global climate. The pollutants act as a blanket, trapping in solar energy that Earth receives from the sun in what is known as the 'greenhouse effect'. The greenhouse effect is essential to sustain life on Earth, but the greater the concentration of pollutants in the atmosphere, the less energy that is able to escape into space, and the more temperatures increase. In the past few

decades, there has been a global increase in the prevalence and severity of respiratory diseases, some of which the Interagency Working Group on Climate Change and Health (IWGCCH) (2010) attributes to climate change; IWGCCH but also insists that a large part of the risk for such illnesses is unclear and that there is still a great need for further research.

1.2.3 Microbial Transmission and Infectious Disease

Increases in global temperature and precipitation events pose yet another great threat to the health of human populations in acting as a driving force for infectious disease outbreaks. While infectious disease is not a leading cause of morbidity or mortality in the United States, warmer temperatures and wet environments are ideal for vector-borne, zoonotic, and waterborne disease outbreaks. Infectious diseases still prevalent in the United States today include Lyme disease, rabies, anthrax, E. coli, and plague, among other bacterial diseases (IWGCCH, 2010).

Despite the fact that vector-borne diseases such as malaria, dengue and yellow fevers, and typhus have been all but eliminated from this country, changes in climate will create an environment more conducive to the spread of these diseases that still ravage some developing countries. Changes in climate suggest changes in the transmission biology of some infectious diseases; scientists predict changes in vector migration and breeding tendencies, physiology, and behavior, as well as changes to dynamics in the pathogens the vectors carry (Chan et al., 1999).

Many of these vector-borne infectious diseases are prevalent in tropical and subtropical areas with climates of high temperatures and rainfall. Malaria, a disease caused by the parasite

Plasmodium and transmitted by mosquitoes, caused 863,000 deaths worldwide in 2008 (Centers for Disease Control, 2010). Multiple studies predict that a global average of 2°C temperature rise could cause malaria to spread to higher altitudes in tropical and subtropical regions, and to even seasonally affect temperate regions as far north as Europe (Chan, et al., 1999). Laboratory experiments also show that dengue fever, a disease also transmitted by mosquitoes, transmitted more efficiently when temperatures were higher (Watts et al., 1987 as cited in Chan et al., 1999). Temperature-driven increases in latitudinal and altitudinal ranges for both malaria and dengue will increase the transmission season and alter the infection potential for temperate regions not previously at risk.

The risk for an outbreak of water-borne disease also increases with warming temperatures and increased precipitation. Research has connected extreme precipitation events with subsequent outbreaks of different diseases; *Escherichia coli* O157:57, *Giardia,* and *Crytosporidium* have each been found in significant concentrations in United States bodies of water after rainfall events when municipal water systems have become overburdened with surges of storm runoff and released untreated water into streams, lakes, and rivers (Curriero et al., 2001). Other water-borne diseases, like cholera and St. Louis encephalitis, also thrive in warmer water temperatures.

As previously stated, although these infectious diseases are not highly prevalent in the United States today, a changing climate threatens to expand the range and biological factors of these diseases that will put a larger portion of the world at risk, including the United States. By changing the ability and area for these diseases to be transported and spread, the capacity also changes for these microbes to directly infect humans or to contaminate food and water quality.

1.2.4 Food Security

Research shows that rising temperatures have a detectable negative global impact on the overall productivity of major crops like wheat, rice, maize, soybeans, and barley. A study that examined the relationship between climate trends and global crop production from 1980-2008 showed that temperatures in agricultural regions that exceeded one standard deviation of historical annual variability saw declines in maize and wheat production by 3.8% and 5.5%, respectively, compared to no deviant climate trends (Lobell et al., 2011). Precipitation largely dictates the occurrence of droughts and floods in regions and, together with temperatures, affects variability and success or failure of crop yield. Further, risks of weather events like droughts also put potable and agricultural water resources at risk.

Changes, especially decreases, in the productivity of major crops have dangerous implications for food security, particularly in areas that are already stressed to provide. Without stable food security, populations are at risk for malnutrition and involvement in violent competition for resources. While food insecurity once again applies to many developing countries rather than the United States, it is important to note that persistent temperature rises may cause an overall consistent decrease in crop yield around the world.

1.2.5 Change in Sea Level

In addition to the many impacts associated with changes in regional temperature and precipitation patterns, global climate change and variability will also affect the cryosphere and average sea levels, and present even greater likelihood of adverse health impacts. Consistent measurements of the “cryosphere,” which consists of mountain glaciers, ice caps, ice sheets,

floating ice, snow, and frozen ground, show retreat and loss of ice over multiple large regions including the Andes, the European Alps, Alaska, Western Canada, and the Canadian Arctic (IPCC, 2007). In addition to causing ice melt and retreat, a warming atmosphere also contributes to rising sea levels by causing the ocean to absorb heat and expand (Environmental Protection Agency (EPA), 2011). Although changes in sea level are difficult to predict and vary considerably on a local and regional basis, The IPCC Fourth Assessment Report (2007) estimates that sea levels have increased between 10 and 15 centimeters (cm) in the past 100 years, and predicts an 18cm to 59cm increase in the next century, a change with certain "overwhelmingly negative" consequences.

The mass loss of glaciers and ice caps causes flooding, instable mountainside slopes, and changes in the runoff patterns of glacial streams. Flooding and rock slides have clear negative implications, and changes in runoff patterns could affect certain areas that depend on seasonal supply of water from melting glaciers. Further, as sea levels rise, salt water intrusion on surface water and groundwater poses a risk to water supplies, particularly for areas in the United States like New York City, Philadelphia, and parts of California that partially rely on such supplies (EPA, 1989). Rises in sea level due to temperature increases could increase both the intensity of tropical storms and the vulnerability of populations in coastal regions, particularly in areas of coastal subsiding (e.g., deltas and coastal cities). In the United States, high-density populations in low lying regions, such as in areas of the Gulf Coast and eastern seaboard, are considered to be most vulnerable to negative impacts (IPCC, 2007).

1.2.6 Mental Health

While climate variation has numerous physical impacts on human health, it is also important to note that the population is also at risk for significant mental health hazards. The Interagency Working Group on Climate Change and Health (2010) highlights the difficulty in addressing the risks and the lack of research exploring the different dimensions of mental health and climate change. Exposure to extreme weather events can affect individuals' feelings of loss or displacement, and create anxiety about social disruption or the future, and potentially cause mental health illnesses like Post-Traumatic Stress Disorder (IWGCCH, 2010; Chand & Murthy, 2008). Further, extreme environments affect elements associated with general well being, such as quality of sleep and relative daily stress levels, and can also breed tendencies of civil conflict (Chand and Murthy, 2008). Experiencing disasters like droughts, floods, or other extreme weather can cause tremendous distress, particularly for those people who suffer property loss. For example, farmers who suffer damages to the land upon which their livelihood depends are particularly vulnerable to mental health effects.

Beyond just extreme environments, research shows that individuals' moods are correlated with climate and can be affected by certain climate factors such as ambient temperatures, rainfall, atmospheric pressure, relative humidity, and hours of sunshine (Chand & Murthy, 2008). Cases of cognitive impairment and obsessive-compulsive disorders have also been linked to individuals who had previously suffered from infectious diseases (Murthy et al., 2001 as cited in Chand & Murthy, 2008).

Individuals who are most susceptible to mental health impacts are those who live in poverty or areas that are vulnerable to extreme weather events, those who are dependent on

agriculture or natural resources for their livelihood, or those who are already susceptible to mental health illness (Chand & Murthy, 2008).

1.4 The Public Health Challenge

While direct, immediate impacts of climate change are perhaps not the most obvious or chief danger to human lives in the United States, both concerns point towards a perceivable if immeasurable threat to the health of populations. Therefore, public health departments today are being called upon to act as the "first line of defense" in addressing these health risks (Balbus et al., 2008). The precautionary principle, a fundamental axiom of the public health sector, calls for the implementation of 'precautionary measures' when a threat to human health or the environment exists, "even if some cause and effect relationships are not fully established specifically" (Wingspread Conference on the Precautionary Principle, as cited in: Frumpkin et al., 2008). The precautionary principle traditionally employs the practice of 'preparedness' in public health agencies today, facilitating research and a state of anticipation and readiness for events that demand a response or particular aid (Frumpkin et al., 2008). The complex nature of climate change makes preparedness a critical strategy, and places public health agencies in a distinctive position of leadership. It is the responsibility of local agencies to prepare and, more specifically, to evaluate human vulnerability and susceptibility to the hazards of climate and to draw conclusions on populations' varying resiliency while making significant efforts to reduce research gaps where uncertainty exists (Keim, 2008).

There is a lengthy list of direct and indirect threats to human health as a consequence of a changing climate, and therefore, an even larger directive exists for public health agencies to

address these risks. However, the level of preparedness within agencies, in addition to appropriate attitudes and perceptions towards climate change, is currently "questionable at best" (Balbus et al., 2008). Further, a cause for even greater alarm is perhaps the low priority of climate change on public and government agendas; more specifically, there is a lack of "public urgency, strong leadership, and political will" (Leiserowitz, 2006).

The following chapter is a review of recent literature on the American public's opinions regarding climate change and its associated risks, as well as why communicating the risks of climate change has proven to be such an immense challenge. The review will also include studies conducted specifically on public health officials and highlight the obstacles agencies face in motivating action to prepare for the health risks of a changing climate.

CHAPTER 2: BACKGROUND ON CLIMATE CHANGE ATTITUDES AND PERCEPTIONS

2.1 Public Perceptions and Attitudes

Since the late 1980s, numerous opinion polls have attempted to gauge the public's levels of awareness, knowledge, degrees of concern, risk perception, and willingness to make trade-offs to mitigate or adapt to negative impacts of climate change (Bord et al., 1998). Over the past three decades public opinions have fluctuated with regard to concern over climate change impacts and how sure the public is that climate change is currently happening and what is causing it. Despite IPCC and National Research Council studies that report consistent increases in scientific consensus on the characteristic phenomena of climate change including a warming climate, human-attributed causes, resulting ecological and human risks, and the ability of humans to affect the magnitude of these risks (Weber and Stern, 2011), trends in public attitudes, risk perceptions, and reported knowledge have not been as encouraging.

Although a large majority of Americans believe that climate change is a "serious problem", as of May 2011, the percent of people who believe global warming is happening had declined from 71% in 2008 to 64%, as had the levels of "how sure" people are that climate change is happening (Leiserowitz et al., 2011). Further, fewer people believe that most scientists think climate change is happening and more people believe that there is disagreement among scientists over the reality of climate change (Leiserowitz et al., 2011). Other research shows that people are no closer to attributing climate change to human-driven causes than they were two decades ago, and that there is a steadily growing belief that climate change is more attributable to natural processes (Reynolds et al., 2010; Pugliese & Ray, 2011; Leiserowitz et al., 2011).

Climate change is also perceived as less of a threat today than it was in the past. Polls from 1989-2003 found that US respondents who reported feeling a fair amount to a great amount of worry about climate change ranged from 63% in 1989 to 58% in 2002, peaking in 2000 at 72% (Saad, 2002). However, in 2011 people reported being considerably less worried than they were in 2008 (53% in 2011 were 'worried', down from 63% in 2008), and 25% of people reported feeling not at all concerned about the health impacts of climate change (Pugliese and Ray, 2011; Leiserowitz et al., 2011).

Despite fluctuations in opinions over scientific consensus, human versus natural causes, and the risks associated with climate change, however, a steady majority of Americans believe that climate change is real and that it is a serious issue. Leiserowitz (2006) characterizes American sentiments about climate change as a paradox: despite steady levels of moderate to high concern, climate change persists as a low-priority issue in comparison to other national and environmental issues. Other studies have supported this idea, showing that the public generally views climate change as an important issue, but less as an immediate personal threat and more as a future risk or a risk for distant developing countries who are more vulnerable to health impacts and less able to adapt (Bord et al., 2000; Bickerstaff et al., 2004). Further, while the American people view climate change as an important problem that should be addressed with relative urgency, it is in most cases regarded as a critical environmental issue but not necessarily as a domestic one (Lorenzoni & Pidgeon, 2005).

2.2 Disparities in Defining and Interpreting Risk

2.2.1 Differences in Expert and Non-Expert Risk Perceptions

In order to make wise decisions regarding risk, individuals must first define and understand both the risk itself and the potential benefits of acting to reduce that risk (Fischhoff et al., 1993). However, because public perceptions of risk often do not align with expert assessments, defining risks becomes particularly challenging and at times controversial (Slovic, 1999). The polarizing potential of the definition of a risk is important because risk experts agree that whoever controls the prevailing definition of risk (for example, the public or the government) also controls the decisions or actions associated with managing the risk (Slovic, 1999; Leiserowitz, 2006; Weber, 2006). The disparities in defining risk arise from the idea that experts define risks based on objective and analytical risk assessments, while the public tends to make risk judgments based on emotions, specifically focusing on things like uncertainty, dread, control, or the catastrophic potential of consequences (Slovic, 1987; Fischhoff et al., 1993; Weber, 2006).

The idea of subjective interpretations of risk makes knowledge a necessary but not adequate determinant of risk perception, such that even if new information comes from a reliable expert source, there are many other factors that dictate how individuals might interpret that information (Huang et al., 2012; Slovic, 1999). An individual's personal experiences, values, priorities, or beliefs have been found to be powerful predictors of risk perceptions, and may even cause people to dismiss or ignore information not consistent with their preexisting views (Huang et al., 2012; Slovic, 1987). For example, the extent to which an individual feels in control or effectively able to avoid the negative impacts of a risk relative to

others can cause some individuals to believe they are less at risk contrary to their actual vulnerability (Lorenzoni & Pidgeon, 2005).

2.2.2 Socio-Demographic Differences in Risk Perceptions

More than just individual opinions and beliefs, studies also point to differences in gender and race influencing risk perceptions (Bord & O'Connor, 1997; Slovic, 1999; Kahan et al., 2007; Flynn et al., 1994). For example, the "white-male effect" (Finucane et al., 2000) explains that white males significantly differ from white females and nonwhite males and females in that they are more skeptical of risk, and generally perceive risks to be smaller and more acceptable (Flynn et al., 1994). Further, Flynn et al. (1994) also found that nonwhite males and females do not demonstrate the same gender differences in judging risks as white males and females (Flynn et al., 1994). It is important to note that where science and technology are concerned, women's believed lack of familiarity and knowledge with either field and their associated risks (an assumption partly based on the fact that there are generally fewer women scientists and engineers relative to males - Firestone, 1970, as cited in: Flynn et al., 1994) was hypothesized to be a source of gender differences in risk perception in initial studies of the white-male effect. However, Barke et al. (1994, as cited in Flynn et al., 1994) found that women scientists still perceive risks from nuclear technologies to be greater than male scientists despite relatively equivalent levels of knowledge between genders. Rather, the white-male effect is believed to be largely attributable to worldviews (e.g., individualistic, anti-egalitarian, hierarchical views) and feelings of control, vulnerability, and social responsibility (Flynn et al., 1994; Bord & O'Connor, 1997; Finucane et al., 2000; Zelenzy et al., 2000; Kahan et al., 2007;).

These attributions of the white-male effect also support affective and subjective factors as drivers of individuals' risk judgments, where individuals who feel more control and less vulnerability and personal responsibility are likely to perceive smaller amounts of risk.

Gender has been found to impact environmental and climate change risks in particular. Multiple studies, for example, found that women consistently showed more concern for environmental problems and were more likely to feel greater risk associated with environmental hazards; however, studies that focused on environmental attitudes rather than environmental risks overall found no gender differences (Flynn et al., 1994; Bord & O'Connor, 1997; Zelezny et al., 2000). With regard to climate change, women are found to perceive greater human health and ecological risks and are more likely to want to take voluntary action to address predicted problems (Bord & O'Connor, 1997). These tendencies might stem from the fact that women are generally more altruistic and inclined to exhibit helpful or nurturing behavior (Gilligan, 1982), and are therefore likely to demonstrate increased levels of concern in any situation with potential for dangerous or harmful impacts.

Political ideology also is a strong indicator of perceptions of risk with regard to the environment and climate change. Research conducted since the 1970s indicates liberal-minded individuals are generally more pro-environmental than conservatives, and that liberals' opinions and levels of concern about climate change tend to align more closely with scientific consensus than conservatives (Dunlap et al., 2001 and sources cited within; Leiserowitz, 2007; McCright, 2010;). Leiserowitz et al. (2010) conducted a national survey in 2007 and divided respondents into 6 distinct global warming audiences based on their attitudes and beliefs about climate change. The researchers found that liberal-minded individuals more commonly fell into

the categories of Americans who are alarmed, concerned, and cautious about the impacts of climate change, while the conservative-thinkers were more likely to be categorized as unconcerned, doubtful, or dismissive (Leiserowitz et al., 2010)

McCright (2010) and Dunlap et al. (2001) have pointed out that the distinct ability of political orientation to predict beliefs about climate change is likely due to the fact that both the reality of climate change and the measures that must be taken to mitigate and adapt to its impacts conflicts with certain values of different ideologies. More specifically, although conservatives might believe the environment is important or that climate change is a problem, protective action creates a fundamental challenge to conservative values: core components of conservative ideology consist of free enterprise, laissez-faire government, and a firmly held status quo, but mitigation and/or adaptation means higher costs for business and industry and a greater presence of government regulations and policies (Dunlap et al., 2001; McCright, 2010). As a result, climate change has become a highly divisive subject over the past decade as certain beliefs about climate change become predominantly associated with different political orientations. Where both policy-makers and the public are concerned, individuals have reinforced the increased polarity of climate change by paying more attention to or accepting information akin to their own views and openly disdaining or dismissing information, such as messages about risks and the need for action, that might conflict with their own beliefs (Dunlap et al., 2001; McCright, 2010; Hart & Nisbet, 2011).

2.3 Improving Understanding and Communicating Risks

Fischhoff et al. (1993) argue that in order to appropriately communicate risks in a way that improves public understanding, communicators must first account for existing levels of knowledge or understanding about a risk before providing more information or details. Despite polls that have estimated levels of public knowledge and years of communication efforts aimed at improving knowledge, there is still a large gap between scientific consensus and public understanding of climate change risk, and research has pointed out a number of reasons that might explain the existence of such a gap. One such reason is that climate change is an intrinsically complicated phenomenon that is challenging for lay populations to understand and difficult for communicators to translate into easily conceptualized models (Dunlap, 1998; Lorenzoni & Pidgeon, 2006; Weber & Stern, 2011). Dunlap (1998) asserts that the fact climate change is such a technically complex issue makes it highly unlikely that lay individuals would become sufficiently interested or informed in the matter. Given the nature of climate change, it is also not surprising that numerous misconceptions about climate change have broadened the gap between scientific and public understanding (Reynolds et al., 2010).

The public currently suffers from misconceptions about climate change that arise both from knowledge deficits and from errors in processing information caused by certain psychological constructs. For example, many people fail to distinguish the differences between climate and weather or between greenhouse gases and general pollution (Reynolds et al., 2010). People mistakenly believe that reducing fossil fuel emissions will cause the atmosphere to quickly "recover," and underestimate how long certain greenhouse gases linger in the atmosphere or just how significantly carbon dioxide emissions must be reduced in order for

atmospheric concentrations to stabilize (Weber & Stern, 2011). Further, many people use their experience of uncharacteristic weather or a single event, such as a snowstorm or heat wave, as a means of confirming or disproving the idea of "global warming." Climate change is a phenomenon measurable through statistical changes (i.e., sea levels or regional temperature ranges), rather than by detectable or observable differences, but certain heuristics cause people to overreact or place more weight on vivid recent events rather than the overall long-term impacts of climate change (Weber, 2010; Weber & Stern, 2011).

The second reason that prevents a better public understanding of climate change stems from the various political and economic framings of climate change communicated by the media that serve to confuse and mislead the public (Weber & Stern, 2011). Common arguments that 'denialists' use to reinforce polarity include claims that: climate change is not happening (supported by idea that climate change cannot be "seen"), that natural processes and not human activity drive climate change, that even if climate change is happening consequences in the United States will be minor if not completely negligible, and finally, that actions to limit greenhouse gas emissions will have catastrophic impacts on the economy (Weber & Stern, 2011). Further, research shows that Americans tend to obtain news from sources that reinforce their own beliefs (i.e., Liberals primarily trust MSNBC or CNN and conservatives rely on FOX News)(McCright, 2010). Communicating climate change in a way that bolsters political divides and emphasizes uncertainty prevents the political and public sectors from getting to the root of the issue and instead creates a scenario where any public concern can be undermined by political "gridlock" (Nisbet & Scheufele, 2009).

A third and final reason for a lack of public understanding of climate change lies in the fact that scientists and laypeople conceptualize issues very differently (Bostrom et al., 1994). Part of the challenge associated with communicating risk to the public stems from factors discussed in the previous section: the fact that there is a substantial difference between lay information processing and expert processing. This difference persists essentially because rather than processing risk information in a predominately analytical or empirical sense, laypersons build their knowledge and perceptions using affect, personal attitudes, beliefs, interests, and values, in addition to the scientific facts (Slovic, 1987; Bucchi, 2008).

Given the factors that might explain the inability of the public to appropriately conceptualize climate change hazards, it is critical that such risks be communicated in a way that would generate a response conducive to appropriate attitudes and action. Properly communicating risk to the public and decision makers begins with understanding the target audience and how the audience feels about the issues (Leiserowitz et al., 2010). When people see something as a risk, they are more likely to do something in order to resolve that risk; since behavior and decision research shows that people do not process risk information from a solely analytical perspective, it is vital that other dimensions of risk be accounted for when attempting to communicate with the public (Lorenzoni & Pidgeon, 2005; Leiserowitz, 2006; Weber, 2006; Kahlor & Rosenthal, 2009). Poor communication attempts that overestimate or underestimate the public's knowledge, that incite unnecessary panic, or create a false sense of security can result in a public response that is just as harmful as the risk that the message initially attempted to convey (Fischhoff et al., 1993; Bostrom et al., 1994)

2.4 Public Health Perceptions

A relatively limited amount of research exists within the public health sector that examines the attitudes, perception, knowledge, and preparedness of agency employees or department heads with regard to climate change vulnerabilities and adaptation and mitigation measures. Research that does exist has been conducted within recent years and follows trends similar to the public with respect to knowledge, awareness and risk perception, and it also examines beliefs about department efficacy.

A national survey of local health departments by the National Association of City and County Health Officials (NACCHO) in 2008 (Balbus et al.) found that respondents did not believe that key "stakeholder" groups (e.g., appointed and elected officials, business leaders, and health care leaders) had sufficient knowledge of potential public health impacts. Further, although the respondents reported a relatively high level of self-knowledge, very few reported that they felt "very strongly" about their level of knowledge. Respondents also indicated relatively high levels of perceived risk of health impacts, but the high-risk perceptions were offset by equally low levels of department efficacy as far as assessing health risks in the respondents' respective jurisdictions and in planning effective adaptation or mitigation programs. Almost all of the respondents reported that their health department had at least one program in place to address health impacts and that their department was planning on implementing further programs. However, despite the recognition of the health risks, the study concluded that there is still a distinctly limited awareness of health impacts within specific jurisdictions and that addressing the health impacts is generally a low priority. The study also

asserted a need for better coordination and collaboration across the public health sector and a greater supply of both human and financial resources.

Similar studies in 2007 and 2010 conducted with public health officers around the state of California (Bedsworth, 2009) and on Environmental Health Directors around the United States (Syal et al., 2011) had findings very similar to the 2008 NACCHO study. Overall, both local public health officials in California and Environmental Health Directors across the country felt considerable awareness and moderate to high levels of risk regarding the health impacts of climate change, but both felt that they needed more information and resources to address the risks. The findings from both studies also reported overall low levels of programmatic activity to address climate change related health impacts that have been developed with climate change in mind.

Local public health officials from the 2007 study in California (Bedsworth, 2009) tended to show more concern about the areas that they have less control over, such as areas vulnerable to extreme weather events and wildfires. The same specific locations the officials considered the most vulnerable had also recently received significant media attention because of a heat wave event and a wildfire. Syal et al. (2011) found that individual differences in the attitudes and perceptions of Environmental Health (EH) Directors regarding risks associated with climate change influenced the degree to which certain public health departments were working to address the risks. Risk perception was found to be a significant indicator of EH Director behavior, and although EH Directors felt climate change was less of a personal threat, most indicated a desire for more knowledge about impacts in their specific jurisdictions and

feelings of low department efficacy and preparedness partly as a result of lacking financial resources or agency support.

The findings of recent studies on decision makers are useful for providing information about where public health departments currently stand and future plans they might have for addressing climate change impacts. However, many gaps currently exist in research about relevant health risks, appropriate adaptation measures, and explanations for why key public health officials may not feel that climate change is a phenomenon with health risks that they should be addressing (Leiserowitz, 2006; Huang, 2012). The public health sector is supposed to be a leader in implementing adaptation and mitigation measures to address health impacts, and it is therefore critical to continue identifying specific factors within public health departments that might be acting as barriers to appropriate action.

CHAPTER 3: METHODS

3.1 Introduction

Ancient records show that the Earth is subject to the natural changes that bring about inevitable fluctuations in the surface temperature of the planet. However, in an industrialized world that is powered predominantly by burning the fossilized form of the gases responsible for regulating the temperature of our atmosphere, humans are met with new concerns. The first being that perhaps the most certain thing about climate change, besides the consensus that it is presently underway and compounded by human activity, is the unpredictability and uncertainty surrounding the event. The second concern then stems from the first in that this uncertainty leaves room for a great deal of skepticism about what this means for humans, and more specifically, the implications for human health and to what extent populations will be forced to adapt to such changes if efforts to mitigate potential effects now are dismissed.

The research reported here was conducted in response to the problem that public health agencies in the United States are largely failing to address the human health impacts of climate change, despite the need for precautionary adaptation and mitigation measures. Recent research suggests public health agencies have failed to prepare for impacts mainly due to a lack of urgency, priority, leadership, and resources. The goal of this project was to identify additional psychological factors that might be preventing individual decision-makers within public health departments from appropriately responding. Understanding psychological constructs that act as barriers to public health action would serve to improve future risk communication efforts targeted toward critical decision makers to ultimately elicit more action-oriented attitudes and behaviors.

This project surveyed Nursing Directors across the United States to determine how their individual attitudes, perceptions, beliefs, and knowledge about climate change and its health impacts might help explain agency responses. It was expected that female Nursing Directors with a positive environmental attitude and liberal political ideology would feel a greater sense of risk, control, and responsibility with respect to climate change and its health risks, and overall have more positive attitudes toward taking action to address relevant risks and generate increased levels of preparedness.

3.2 Research Design and Sample

We conducted an online survey using a system called Checkbox® that sent a link to the survey via the email addresses of Nursing Directors located across the country. Nursing Directors were located using Internet searches, specifically through Google searches for "state public health Nursing Directors" and "state public health nursing departments", state public health websites, and county-by-county searches for local health departments. All available email addresses were collected and transferred to Checkbox for survey administration. A total of 786 Nursing Directors were located and included in the initial sample.

The survey took place over a four-week period from March 15 to April 16 of 2010. A pre-invitation and full-invitation to participate were sent out with the survey on March 15, followed by three reminder emails sent 7-8 days apart. Final responses were received on April 13th before the survey closed three days later. The final sample consisted of 165 respondents for a final response rate of 21%.

3.3 Survey Measures

The variables of interest in this study were Nursing Directors' attitude toward the environment, a variety of measures specific to climate change and related health impacts, and the perceived role of their department in addressing impacts. Socio-demographic items included age, gender, level of education, educational background, race, ethnicity, and political ideology. The specific items and scales used to measure the psychological constructs are detailed below.

To assess environmental attitude we measured responses to eight items adapted from Van Liere and Dunlap's New Environmental Paradigm (Dunlap and Van Liere, 1978). Respondents were asked to indicate on a 7 point scale the extent to which they agreed or disagreed about certain statements regarding the relationship between humans and the environment (where -3 = strongly disagree, 3 = strongly agree, and 0 = neither agree nor disagree) (see Table 3.1).

To assess general sentiments about climate change, Nursing Directors were asked to indicate their level of awareness, their attitude, and their beliefs about both the cause and controllability of climate change, as well as their beliefs about how the climate system works. Awareness measures were taken from Balbus et al. (2008) and asked about impacts of climate change in Nursing Directors' jurisdictions in the past two decades and the next two decades (see Table 3.1). Attitude toward climate change and beliefs about the cause and controllability of climate change were each measured on semantic differential scales, using word pairs that denote opposing viewpoints (i.e., "bad" – "good"; "completely natural" – "completely human"; "completely controllable" – "completely uncontrollable") (Osgood et al., 1957) (see Table 3.1).

In order to assess Nursing Directors' beliefs about how the climate system works, we adapted a set of five pictures from Leiserowitz (2005) that use an analogy of a ball balanced on a line to represent the climate system. Each picture included a short statement and depicted five different perspectives about the ability of the climate system to withstand disturbances. Nursing Directors were asked to indicate which of the five images and corresponding statement best represent their understanding of how the climate system works (See Figure 3.1).

To assess general sentiments about the health-related impacts of climate change, we measured Nursing Directors' attitudes towards action, knowledge, and risk perception. Attitude towards action was measured by two items taken from Kahlor and Rosenthal (2009) that were also each scaled using opposing word pairs (i.e., "bad" – "good" and "worthless" – "valuable") (see Table 3.1). To measure knowledge, the survey asked Nursing Directors to report both their own level of knowledge on a scale of 0 to 10 (where 0 = no knowledge and 10 = know everything there is to know) about the potential health impacts of climate change in their jurisdiction, and where they believe their level of knowledge should be in order to plan appropriately (see Table 3.1); the difference between the items denotes a knowledge gap measure. In addition to knowledge level, the survey also asked Nursing Directors to indicate how easy they think it is to locate relevant and necessary information about health-related impacts (see Table 3.1). Four items adapted from Leiserowitz (2006) were used to determine risk perception toward the health impacts of climate change; Nursing Directors were asked about their overall concern for the health impacts and then asked to indicate how serious they think health impacts will be with respect to location (e.g., their jurisdiction, the United States, and the world) in the next two decades (see Table 3.1).

To assess the role of Nursing Directors in addressing the health related impacts of climate change, we measured Nursing Directors' perceived responsibility, as well as beliefs about efficacy and preparedness within their public health departments. Responsibility was measured using a single item that asked Nursing Directors to indicate to what extent they agreed that their public health department has a responsibility to address health impacts. Efficacy was measured with two items that asked whether Nursing Directors believe their departments had the ability to each address and reduce health impacts. Preparedness was measured with two items from the survey asking Nursing Directors to what extent they believe their department is prepared to address impacts and whether addressing public health consequences of climate change is a priority in their department.

To assess awareness of specific health-related impacts we asked Nursing Directors to indicate whether each specific impact has already increased or will increase in the next 20 years as a result of climate change (see Table 4.4 for the list of impacts). In order to measure behavior, Nursing Directors were then asked to indicate if there currently is, or soon will be, an area of programmatic activity in their department related to each specific health impact.

The survey concluded with questions that measured socio-demographics of interest. In addition to age and gender, the survey also asked about Nursing Directors' level of education (scaled from high school diploma to a doctoral or professional degree), educational background (nursing, physical science, social science/public administration, life science, nursing and public health, or public health), race (Caucasian, African American, American Indian/Alaskan Native, Asian, Hawaiian/Other Pacific Islander), ethnicity (of Hispanic origin or not), and political

ideology (measured on a 7-point scale where 1 = very conservative, 4 = moderate, and 7 = very liberal).

Table 3.1. Variables included in the survey and the items used to measure the variables.

Variable	Survey Items	Source
Environmental attitude[a]	We are approaching the limit of people the earth can support.	Dunlap and Van Liere, 1978
	Humans have the right to modify the natural environment to suit their needs.*	
	When humans interfere with nature it often produces disastrous consequences.	
	The earth has plenty of natural resources if we just learn how to develop them.*	
	Plants and animals have as much as a right as humans to exist.	
	The balance of nature is strong enough to cope with the impacts of modern industrial nations.*	
	Humans are severely abusing the environment.	
	Humans will eventually learn enough about how nature works to be able to control it.*	
Awareness[a]	Your jurisdiction has experienced climate change in the past 20 years.	Balbus et al., 2008
	Your jurisdiction will experience climate change in the next 20 years.	
Climate change attitude	To what extent is climate change completely natural or completely human?[b]	n/a
	To what extent is climate change bad or good?[c]	
	To what extent is climate change controllable or uncontrollable?[d]*	
Attitude towards climate change action	To what extent is addressing the potential health-related impacts of climate change through the public health system bad or good?[c]	Kahlor and Rosenthal, 2009
	To what extent is addressing the potential health-related impacts of climate change through the public health system worthless or valuable?[e]	
Knowledge	What is your level of knowledge about the potential health-related impacts of climate change in your jurisdiction?[f]	n/a
	Where do you think your knowledge should be about the potential health-related impacts of climate change in your jurisdiction?[f]	
	I am easily able to locate information on the potential health-related impacts of climate change.[a]	
Climate change risk perception[a]	I am concerned about the health impacts of climate change.	Leiserowitz, 2006
	In the next 20 years, the health-related impacts of climate change will be serious in my jurisdiction.	
	In the next 20 years, the health-related impacts of climate change will be serious in the United States.	
	In the next 20 years, the health-related impacts of climate change will be serious around the world.	
Perceived responsibility[a]	My nursing or public health department has a responsibility to address the health-related impacts of climate change.	n/a
Department efficacy[a]	My nursing or public health department has the ability to address the health-related impacts of climate change.	n/a
	My nursing or public health department can decrease the health-related impacts of climate change in my jurisdiction.	
Preparedness[a]	My nursing or public health department is prepared to address the health-related impacts of climate change.	n/a
	Addressing the public health consequences of climate change is a priority in my nursing or public health department.	

[a] Measured on 7-point scale where -3 = strongly disagree, 3 = strongly agree, and 0 = neither agree nor disagree
[b] Measured on 5-point scale were 1 = completely natural and 5 = completely human
[c] Measured on a 7-point scale where -3 = bad, 3 = good, and 0 = neither good nor bad
[d] Measured on 7-point scale where -3 = controllable, 3 = uncontrollable, and 0 = neither controllable nor uncontrollable
[e] Measured on a 7-point scale where -3 = worthless, 3 = valuable, and 0 = neither worthless nor valuable
[f] Measured on a 10-point scale where 0 = no knowledge at all and 10 = know all that there is to know
*. Items were reverse-coded to correct for negative wording in combined measures.

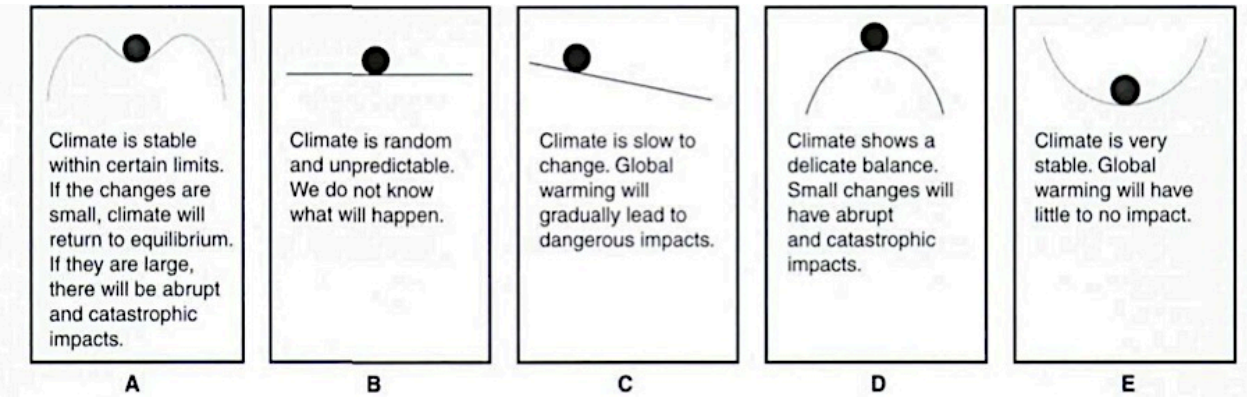


Figure 3.1. The measure gauging how respondents believed the climate system worked and its ability to withstand disturbances.

3.4 Instrument Development

After the initial survey items were developed, focus groups and a pilot survey were conducted to assess content and face validity. Two focus groups, one of Ohio Environmental Health Directors from city and county health departments and another of Ohio Public Health Nursing Directors, allowed for feedback and comments on the quality and perceived effectiveness of the questions in the survey. The survey was modified based on the feedback of these groups. The pilot study consisted of a small group of faculty and graduate students in the Environmental Social Science research lab at Ohio State. In addition to building the measures based on the available literature, their feedback served to make sure the survey items would appropriately measure the variables of interest. After discussion, further feedback, and additional modifications, a final version of the survey was completed (see Appendix A). The final survey was 16 pages long and took an average time of 23 minutes to complete.

To assess whether response bias was present, an abbreviated survey was sent out to all non-respondents in June 2010. This survey included questions very similar to the original

instrument, including measures of attitudes and perceptions toward climate change and its health impacts, department preparedness and efficacy, and what programmatic activities public health departments have in place to address health impacts. Socio-demographic data included age, level of education, political views, and race. Similar to the initial survey, the non-respondent survey included a pre-invitation email, an email with the survey link, and three reminder emails. The non-response survey was completed by a total of 90 individuals for a response rate of 14.3% with no major differences found between the two sample populations on any of the matching measures.

3.5 Research Questions and Hypotheses

Five variables were selected to examine their causal effect on both the attitudes and behaviors of Nursing Directors. Specifically, the research questions were as follows:

1. *To what extent do gender, environmental attitudes, and political views individually influence Nursing Directors' feelings of responsibility, risk perception and control associated with the health impacts of climate change?*
2. *How well do perceived responsibility, risk perception and control predict Nursing Directors' attitude toward taking action and the presence of behaviors (i.e., programmatic activities) to address the health impacts of climate change?*

It was expected that the individual variables of gender, environmental attitude, and political ideology would most accurately predict perceived levels of risk and responsibility, which would in turn significantly influence attitudes toward action. A model containing these select five

variables was expected to best explain variance in agency action (See Figure 3.2). Specific hypotheses were as follows:

- **H_1**: Female Nursing Directors with a positive environmental attitude and liberal ideology will feel a greater sense of responsibility, control and perceived risk toward the health impacts of climate change.

- **H_2**: Nursing Directors with a greater sense of responsibility, control, and perceived risk will have a more positive attitude towards action.

- **H_3**: The more positive the attitude towards action, the more likely it is that Nursing Directors will have programmatic activities in place to address the health impacts of climate change.

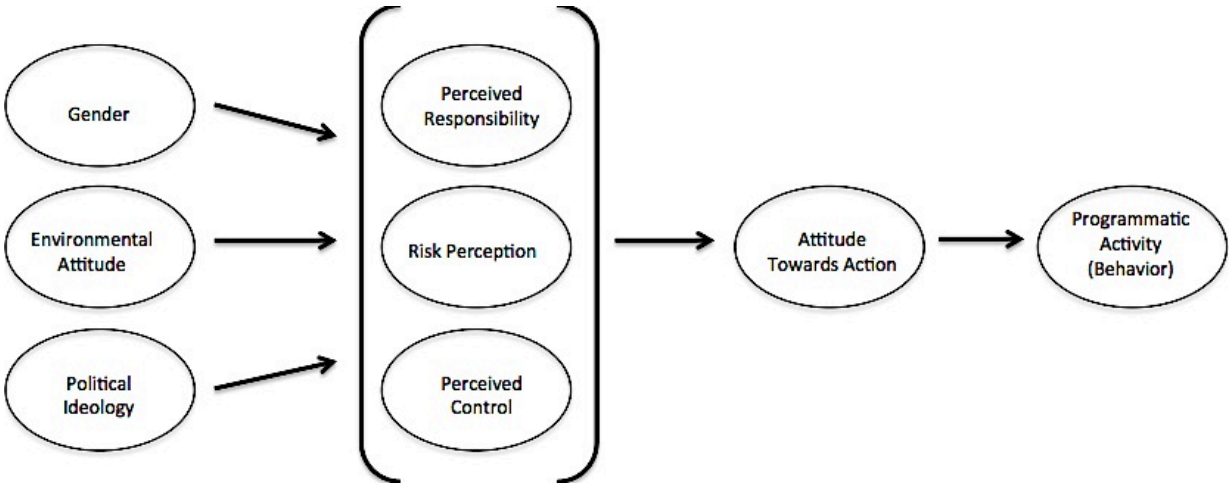


Figure 3.2. The expected path relationship between selected independent variables and the dependent variable.

3.6 Analyses

Items from the survey that were intended for use in a combined measure (e.g., environmental attitude, risk perception, attitude towards action, efficacy, and preparedness) were assessed using Cronbach's Alpha for reliability. Prior to testing the reliability of a potential measure, items that were negatively worded in order to avoid response bias were reverse

coded, namely certain items used to measure environmental and climate change attitudes (See Table 3.1).

Frequency analyses generated descriptive statistics that were used to quantitatively characterize the sample, and correlation analyses were used to determine the strength of bivariate relationships, particularly between the selected potential predictor variables. Hierarchical multiple regression was used to establish the independent predictive power of selected variables, specifically gender, environmental attitude, political ideology, risk perception, and perceived responsibility in explaining the variance in attitudes and department behavior, the dependent variable.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Descriptive Results

Tables 4.1 and 4.2 summarize descriptive results for all item measures, including Cronbach's alpha scores for all combined measures. Of the respondents, 93.7% were female and 6.3% were male. Over three-quarters (80%) had received either a bachelor's or master's degree (43% and 37%, respectively). Almost all of the respondents were white (92.9%); 5% were African American, 1.4% were American Indian or Alaskan Native, and less than 1% were Asian. Political views were evenly spread among respondents: 34.4% reported having conservative views, 31% had moderate views, and 36.6% had liberal views. Of those who reported having conservative or liberal views, only a small percentage indicated having "extreme" views (1.4% and 4.2%, respectively); 31% of those with conservative views were "slightly conservative" to "conservative" and 32.4% of liberals were "slightly liberal" to "liberal". Given the disproportionate response variance of males and females found after running initial descriptive statistics, the item measuring gender was excluded from further analysis measures and removed from the list of potential predictor variables.

A large majority (82%) of the respondents had a positive environmental attitude, and more than half (66%) had negative feelings about climate change with only 6.1% reporting that climate change is 'good' (Table 4.1). Most Nursing Directors (80%) also responded that large changes in the climate system rather than small ones would have the most dangerous impacts. Specifically, 48% believe that climate is stable to an extent and that small changes will naturally return to equilibrium but that large changes will lead to abrupt and catastrophic impacts, and 32% believe that a changing climate will gradually lead to negative impacts. Fewer Nursing

Directors believe that the climate system is completely random and unpredictable (9.1%), that the climate is delicate and even the smallest changes can lead to sudden and catastrophic consequences (5.5%), or that the climate is completely stable and neither large nor small changes will have consequences (4.3%). Respondents also tended to believe that climate change is a controllable phenomenon (49.7%) rather than uncontrollable (35.8%) (See Table 4.2), and that climate change is either driven mostly by human causes (45.4%) or by a balance of human and natural causes (43.6%) rather than solely natural ones (11%). Nursing Directors reported high levels of awareness about climate change occurring within their jurisdiction. Specifically, 84% of respondents agree that their jurisdiction had experienced climate change in the past 20 years, and 83% believe that their jurisdiction will experience climate change within the next 20 years (Table 4.2).

Table 4.1. Descriptive results for attitudinal measures indicating sample size, mean response, standard deviation, Cronbach's alpha score for combined-item measures, and percent responses classified as negative, neutral, or high on a 7-point scale (See Table 3.1 for specific item scales).

Variable	N	Mean	SD	α	% Negative	% Neutral	% Positive
Environmental Attitude	121	0.83	0.95	0.63	13.20	5.00	81.80
Climate Change Attitude	165	-0.99	1.05	N/A	66.1	27.9	6.1
Attitude Towards Action	162	1.2	1.39	0.86	8.0	14.8	77.1

With regard to knowledge about health-related impacts of climate change within Nursing Directors' specific jurisdictions, almost half of respondents (48%) indicated low levels of self-reported knowledge and almost all respondents (94%) felt that there was a considerable knowledge gap between their current knowledge and where their knowledge should be in order to make informed decisions (Table 4.2). More respondents (41.3%) believe that it is more difficult than it is easy (37.6%) to locate information about the health impacts of climate change, and 21.3% feel that it is neither difficult nor easy (Table 4.2). About three-quarters (77%) of respondents feel positively about taking action to address the health-related impacts, and the majority (67%) perceives high levels of risk associated with the health impacts (Table 4.2). Most Nursing Directors (83%) are concerned about the health impacts in their jurisdiction, but tend to feel that health impacts would be more serious elsewhere in the United States (76.5%) and around the world (81.4) rather than in their specific jurisdictions (64.9%) in the next 20 years.

Half (51%) of the Nursing Directors who responded agree that their public health department has a responsibility to respond to the health-related impacts of climate change, but the majority agree that levels of department efficacy and preparedness were generally low (54% and 85%, respectively) (Table 4.2). Specifically, only 21.8% of respondents agree that their public health department has the ability to respond to health impacts and 37% believe their department's actions can decrease the negative health impacts within their jurisdiction. Further, only 10% of respondents agree that their public health department is prepared to respond to the health impacts (75% disagree), and only 8.1% agree that addressing the health impacts is one of their department's priorities (75% disagree).

Table 4.2. Descriptive results for survey measures indicating sample size, mean response, standard deviation, Cronbach's alpha score for combined-item measures, and percent of responses classified as low, neutral, or high on respective scale (See Table 1 for specific item scales).

Variable	*N*	*Mean*	*SD*	α	*% Low*	*% Neutral*	*% High*
Perceived Knowledge	161	4.54	1.67	N/A	48.4	23.6	27.9
Knowledge Gap	159	3.28	1.71	N/A	1	5	94
Ease in Locating Information	160	-0.24	1.50	N/A	41.3	21.3	37.6
Risk Perception	162	1.17	1.39	0.947	11.7	4.9	66.9
Perceived Responsibility	161	0.4	1.59	N/A	24.8	24.2	51
Perceived Control	165	-.13	1.46	N/A	35.8	14.5	49.7
Efficacy	161	-0.51	1.37	0.753	54.1	20.5	25.4
Awareness	146	1.5	1.40	.919	8.4	6.2	84.9
Preparedness	159	-1.5	1.23	.720	84.8	6.9	8.3

When asked about specific health impacts, Nursing Directors tend to most agree that flood-related displacement (55%), vector-borne diseases (58%), air quality-related illness (52%), and mental health illnesses (53%) are the impacts that have already increased or will increase within the next 20 years as a result of climate change. For all specific health risks listed in the survey, at least 32% of respondents felt there currently is or will be some effect of each hazard due to climate (Table 4.4). Water availability-related illnesses and malnutrition are the health-related impacts Nursing Directors believe are least likely to increase in the next 20 years due to climate change (32% each) (Table 4.3).

Table 4.3. Respondents were asked to indicate whether they thought specific health impacts had already increased or will increase in the next 20 years as a result of climate change.

Impact	*% Yes*	*% No*	*% Don't Know*
Heat-related illness	44	30.7	25.3
Flooding-related displacement of residents	55.4	31.1	13.5
Vector borne infectious disease	57.7	21.5	20.8
Waterborne disease	45.3	35.3	19.3
Foodborne disease	49.7	34.2	16.1
Water availability related illness	32.4	48	19.6
Air quality related illness	52.4	32.7	15
Malnutrition	31.5	49.7	18.8
Disruption of health care services during extreme weather events	49.7	37.6	12.8
Anxiety, depression, or other mental health conditions	53.1	24.5	22.4
Cold-related illness	33.1	43.9	23
*Other impacts in jurisdiction**	10.0	31.4	58.6

When asked to indicate specific health impacts that currently or soon will be an area of programmatic activity within their public health department, 52% of Nursing Directors responded that they currently have no programmatic activities nor do they have any planned for the near future to address specific health impacts of client change. 32% responded that they have or will soon have 1 to 6 programs in place to address at least 1 of the 12 listed health impacts, and 15.7% have or will have 7 to 12 programs in place. Due to the skewed nature of responses intended to measure the behavior of Nursing Directors after running descriptive statistics, behavior was eliminated as the dependent variable to be measured by the potential predictor variables. Instead, attitude towards action, the potential predictor variable for behavior, became the main dependent variable. After running descriptive statistics, the research questions were amended to exclude gender and behavior given they did not meet the necessary statistical assumptions:

1. *To what extent do environmental attitudes and political views individually influence Nursing Directors' feelings of responsibility, risk perception and control associated with the health impacts of climate change?*
2. *How well do perceived responsibility, risk perception and control predict Nursing Directors' attitudes about taking action to address the health impacts of climate change?*

The initial hypotheses of the project were also modified as follows:

- **H_1**: Nursing Directors with a positive environmental attitude and liberal ideology are more likely to feel a greater sense of responsibility, control, and perceived risk toward the health impacts of climate change.
- **H_2**: Nursing Directors with a greater sense of responsibility, control, and perceived risk are likely to have a more positive attitude towards taking action to address the health impacts of climate change.

4.2 Bivariate Correlations

In order to establish the relative strength and direction of the linear relationship between pairs of variables, particularly those selected as potential predictors of Nursing Directors' attitude towards action, and as preliminary testing of hypotheses, correlations between all variables were run (see Table 4.4 for correlation coefficients and the statistical significance of each coefficient). Correlation statistics obtained were Pearson's product-moment correlation (r). Values ranging from r= ±.30 to .49 were considered moderate correlations, and values ranging from r= ±.50 to 1.0 were considered strong correlations (Cohen, 1988). The correlations discussed below focus first on those among the five potential predictor variables (environmental attitude, political views, risk perception, perceived

responsibility, and perceived control), between the dependent variable, attitude towards action, and secondly focus on strong correlations between other variables in the instrument.

Nursing Directors who have a more positive environmental attitude feel a greater sense of responsibility and risk associated with health impacts and have a more positive attitude towards action. Those with a positive environmental attitude were also more likely to feel climate change is controllable and have a positive attitude towards taking action. Liberal-minded respondents also tend to perceive greater risk of health impacts and feel that climate change is controllable, in addition to feeling positively about taking action to address health impacts. Further, Nursing Directors who perceive greater risk of health impacts also feel climate change is more controllable, feel more responsible to address impacts, and feel that action should be taken to address the health impacts.

There was a strong correlation between Nursing Directors who feel both that they are more aware of climate change impacts in their jurisdiction and that climate change is attributable to anthropogenic rather than natural causes. Nursing Directors who felt this way about their level of awareness and about the cause of climate change were also more likely to be liberal-minded, have a positive environmental attitude, feel climate change is controllable, perceive greater risk and responsibility towards health impacts, and feel that action should be taken to address health impacts. Respondents who perceive high levels of efficacy within their departments also feel a greater sense of responsibility towards responding to health impacts and feel there is greater preparedness within their department.

Table 4.4 Pearson's Correlation coefficients of all variables selected from the instrument.

Variable	*Climate Change Attitude*	*Cause*	*Awareness*	*Attitude Towards Action*	*Knowledge Gap*	*Risk Perception*	*Responsibility*	*Efficacy*	*Preparedness*	*Control*	*Political Views*
Environmental Attitude	-.392***	.492***	.585***	.323***	.257***	.552***	.313***	.127	.662**	-.297***	.233
CC Attitude	1	-.468***	-.451***	-.280***	-.190*	-.480***	-.242**	-.093	-.027	.382***	-.451***
Cause		1	.513***	.386***	.222**	.573***	.344***	.153	.009	-.478***	.399***
Awareness			1	.498***	.186*	.794***	.396***	.124	.056	-.399***	.371***
Attitude Towards Action				1	.232**	.583***	.550***	.348**	.194*	-.415***	.314***
Knowledge Gap					1	.274***	.153*	.023	-.225**	-.167*	.215*
Risk Perception						1	.583***	.348**	.238**	-.434***	.302***
Responsibility							1	.646**	.482***	-.287***	.183*
Efficacy								1	.662**	-.090	.003
Preparedness									1	.016	-.019
Control										1	-.325***
Political Views											1

***. Correlation is significant at .001 level (2-tailed)

**. Correlation is significant at .01 level (2-tailed)

*. Correlation is significant at .05 level (2-tailed)

4.3 Hierarchical Multiple Regression

Hierarchical multiple regression tests how well a certain independent variable or set of independent variables is able to predict variance in the dependent variable. After checking that the assumptions of normality, linearity, multicollinearity, and homoscedascity had been met, variables were entered in steps and each independent variable was assessed in terms of its influence on the dependent variable after controlling for the other independent variables. Table 4.5 displays the R square values, beta coefficients, and statistical significance for all variables included in the hierarchical regression, and Figure 4.1 illustrates the conceptual path model meant to depict the potential relationships of independent variables to one another and the dependent variable.

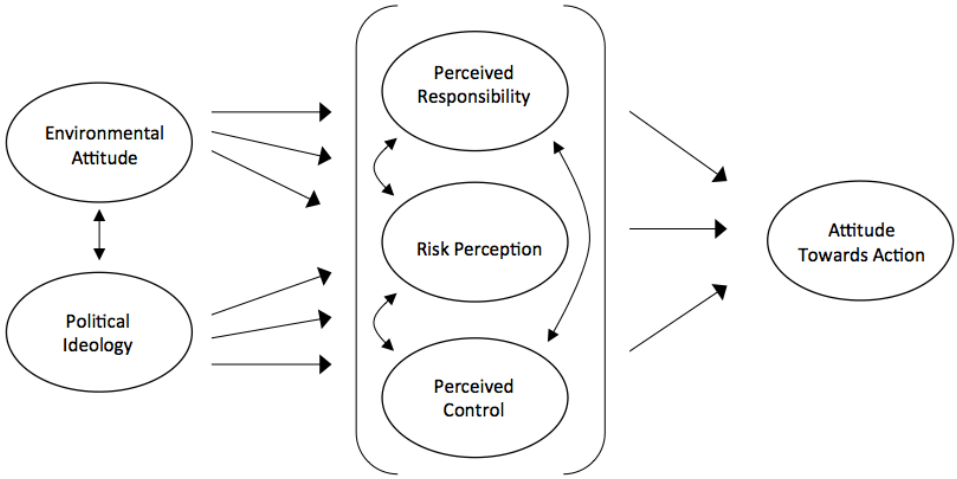


Figure 4.1. The potential path relationship between selected independent variables to one another and to the dependent variable. Single-sided arrows denote causal relationships and double-sided arrows denote correlations.

Environmental attitude and political views were entered in Step 1 of the regression and explained 16.4% of the variance in attitude towards action (Table 4.5). After adding perceived responsibility, risk perception, and perceived control in Step 2, the total variance explained by the model as a whole was 42.7%. After controlling for environmental attitude and political views, the three variables of perceived responsibility, risk, and control explained an additional 29.2% of the variance in attitudes towards action (R square change = .292). In the final model, only two of the five variables were statistically significant, perceived responsibility and risk perception, with risk perception achieving a higher beta value (beta = .328, $p < .01$) than perceived responsibility (beta = .318, $p < .001$)(Table 2.6).

Table 4.5 Beta coefficients obtained from hierarchical multiple regression.

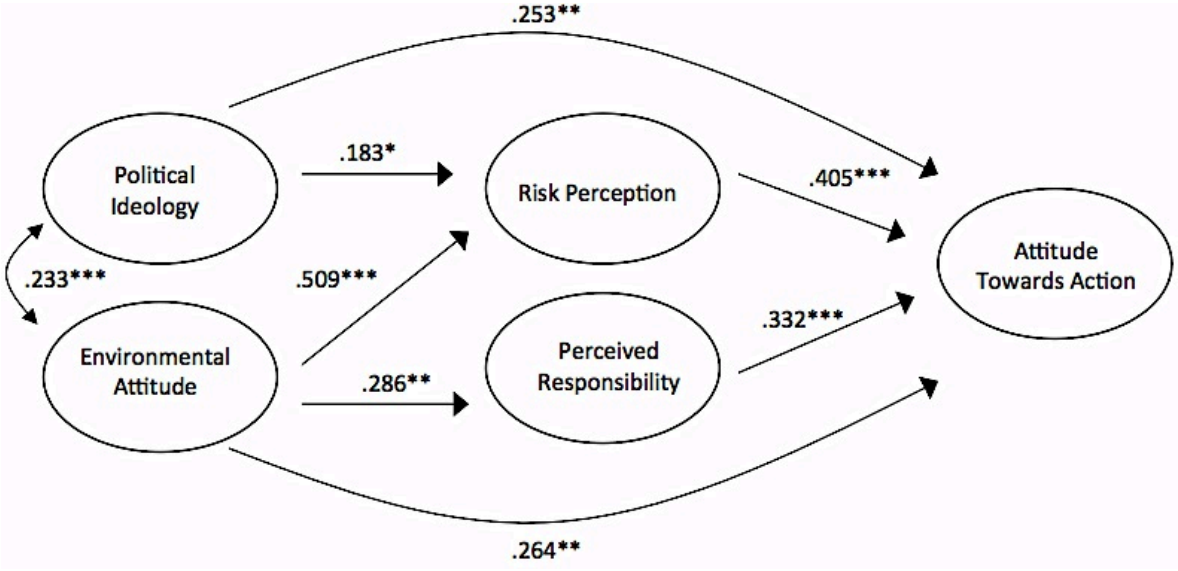
Independent Variables	***Block 1***	***Block 2***
Environmental attitude	.264*	-.030
Political ideology	.253*	.114
Perceived responsibility		.318**
Risk perception		.328*
Perceived control		-.154
R Square	.164	.427
R Square Change		.292

*Significant at .01, **Significant at .001

4.4 Simple Path Analysis

After running the initial hierarchical multiple regression, standard multiple regression was run on a simpler model that excluded perceived control and included only pathways that were statistically significant. Variables were evaluated in terms of individual predictive power

on one another and on attitude towards action. Specifically, environmental attitude and political ideology were evaluated for their direct and indirect effect on attitude towards action and risk perception and perceived responsibility for their direct effect on attitude towards action (See Table 4.6). Figure 4.2 depicts the simplified potential path model including beta values.



*. Significant at .05, **. Significant at .01, ***. Significant at .001.
Single-sided arrows indicate causal relationships and double-sided arrows indicate correlation.
Figure 4.2. Simplified potential path model. Values are beta coefficients from standard multiple regression. Single-sided arrows indicate causal relationship and double-sided arrows indicate correlation.

Table 4.6. Beta coefficients for the direct effect and indirect effect of independent variables on the dependent variables, and the total effect of the independent variables. Total effect was calculated by multiplying beta coefficients of each indirect pathway from an independent variable to the dependent variable.

Independent Variable	Direct Effect	Indirect Effect	Total Effect
Environmental Attitude	.264	.301	.565
Political Ideology	.253	.074	.327

The model describes which variables make the strongest unique contribution to explaining variance in the dependent variable when the variance explained by all other variables is controlled for. Environmental attitude, political ideology, risk perception, and perceived responsibility each made a statistically significant ($p < .05$, .01, or .001) unique contribution to explaining the variance in attitudes towards action. It was expected that environmental attitude and political ideology would have the most influence on attitude towards action indirectly by directly increasing perceived risk and responsibility.

Environmental attitude has a greater total effect on attitude towards action when directly increasing risk perception and perceived responsibility, explaining 56.5% of the variance, compared to political ideology, which explains 32.7% of variance. The greatest indirect effect of environmental attitude is through increasing perceived risk: Environmental attitude explains 50.9% of variance in risk perception and risk perception explains 40.5% of variance in attitude towards action. Political ideology has a much greater direct effect on attitudes towards action, explaining 25.3% of the variance, than when combined with risk perception where political ideology explains 7.4% of the variance.

4.5 Discussion

This project was conducted as an attempt to understand certain psychological factors that might currently be preventing Nursing Directors from adopting attitudes and behaviors that are conducive to addressing the health impacts of climate change within their jurisdictions. In recent decades, social science research has shown that individual factors such as personal experience, affect, values, priorities, and other beliefs can be more powerful drivers in

judgment and decision-making than empirical facts. The findings of this project overall were consistent with both surveys of the American public about climate change and with studies that have specifically focused on public health officials with regards to climate change awareness and levels of knowledge and risk associated with health impacts. Further, despite not being able to include Nursing Directors' behavior in analyses, the results of this study at least supported the idea that certain individual factors (i.e., environmental attitude, political ideology, risk perception, and perceived responsibility) can help explain variance in attitudes that could influence relevant behaviors.

Nursing Directors who feel positively toward the environment are also more likely to feel positive toward taking action to address health impacts; this finding is consistent with research that has found pro-environmental attitudes cause individuals to feel considerably more likely to support risk management action (Kellstedt et al., 2008; Bord & O'Connor, 1998). Further, liberal-minded ideology explains variance in both risk perception and attitudes towards action, a finding consistent with research that has shown political ideologies have strong direct influences on individuals' attitudes and perceptions, particularly in the case of contentious issues. Other research has demonstrated that even in the case of exposure to factual information, partisan individuals or audiences are motivated to interpret and accept or reject information in a way that reinforces their preexisting beliefs, and that certain messages can intensify polarization about an issue (Hart & Nisbet, 2011). Given that liberal ideology had a medium-strength correlation with risk perception ($r = .302$) and attitude towards action ($r = .314$), it is possible that reported opinions about climate change were a result of Nursing

Directors linking their respective political identities to a controversial and politically charged issue.

Nursing Directors' perceptions relate to findings about the American public and public health officials in that they indicated high levels of awareness and concern about climate change, but do not necessarily perceive risks associated with climate change to be immediate, a high priority, or particularly dangerous within their jurisdiction (Leiserowitz, 2005; Bedsworth, 2009). Although over three-quarters of Nursing Directors feel positively about the environment and about taking action and over half perceive the risk associated with impacts, only a slight majority feel that climate change is bad, and an even smaller percentage feel responsible for taking action. Further, less than one-third of Nursing Directors feel their department is able to respond and reduce negative impacts. This disparity in attitudes and perceptions might be because there are considerable knowledge gaps about relevant health risks within jurisdictions, and research suggests that higher amounts of information or knowledge is linked to greater understanding of relevant risks, which increases feelings of responsibility, efficacy, and risk (Kellstedt et al., 2008; Sundblad et al., 2009; Kahlor & Rosenthal, 2009; Reynolds et al., 2010). Almost all Nursing Directors indicated that there is a large knowledge gap between where knowledge currently is and where knowledge should be about health risks of climate change, and responses that indicated Nursing Directors "don't know" about specific health impacts in their jurisdiction ranged from 13.5% to 25.3%. Given that greater amounts of knowledge are believed to increase factors such as responsibility, efficacy, and risk, it is important to note that Nursing Directors' feelings of responsibility and efficacy show strong, positive correlations with attitudes towards action.

However, while knowledge might be critical to understanding risk and might influence individual perceptions, it is not necessarily a sufficient means of ensuring appropriate decision-making or behaviors (Huang et al., 2012; Slovic, 1999). Rather, despite exposure to greater amounts of information, the way that individuals interpret that information is largely affected by factors like personal experience, beliefs, and values or priorities (Huang et al., 2012). Individuals process risk in a similar fashion; depending on different psychological or social constructs, people will pay more attention to, fear, or amplify certain risks while ignoring, dismissing, or tempering other risks, tendencies also based predominantly on preexisting beliefs, values, or experiences (Leiserowitz, 2006). Further, research has shown that risk perception is a powerful predictor of behavior (Weber, 2006; Syal, 2011; Leiserowitz, 2006). In this study, risk perception was not only strongly and positively correlated with attitude towards action, but also made the strongest unique contribution to explaining the variance in attitude towards action, particularly when a positive environmental attitude was included in the path. Such findings suggest that Nursing Directors' risk perceptions are not only an important influence on their attitudes toward taking action, but that their feelings of risk are also influenced by environmental attitudes and political ideologies.

This study focused on key administrators within public health agencies who are in decision-making positions and aimed to identify specific psychological or social constructs of Nursing Directors that might explain variance in attitudes and behaviors. The results of this study highlight the importance of individual factors, specifically environmental attitudes, political ideology, risk perception, and perceived responsibility, for predicting attitudes towards action. Practical applications of the results of this study are discussed below.

4.6 Conclusions and Implications

In recent years there has been a slight shift in the "central question" of climate change; where leaders and decision-makers used to debate primarily over the accuracy or legitimacy of climate change and its associated risks, the greater debate today has transformed into a question regarding the appropriate course of action to effectively adapt to and mitigate the impacts of the phenomenon (Mearns, 2010). The call for public health agencies to take action has placed a greater emphasis on decision-makers and has shed light on the problem that many public health departments across the United States are currently failing to appropriately respond.

Communication research has found that appropriately framing risk messages intended for audiences that have been specifically targeted because of their similar beliefs, behaviors, or motivations is an effective means of ensuring individuals appropriately receive and interpret risk communications (Maibach et al., 2008; 2010; 2011; Leiserowitz et al., 2010; Hart & Nisbet, 2011). The notion that "one size fits all" when it comes to risk messages is more appropriately supplanted by the idea that the "general public" does not exist, but rather smaller and homogenous audiences exist within the public (Maibach et al., 2008). Therefore, messages about the health impacts of climate change should be specifically tailored to fit the needs and context of certain audiences, aiming both to reduce knowledge gaps and to resonate with specific values held by particular audiences.

Since risk perception is found to be a major predictor of action across research and a powerful predictor of attitudes in this project, communication efforts to increase feelings of risk associated with the health impacts of climate change are critical to eliciting more appropriate

agency responses. For those who already feel high levels of risk associated with climate change health impacts, information messages could focus on improving personal efficacy, such as informing what actions individuals can take, how to take them, and specific policies to support (Maibach et al., 2008). For those who associate little risk with climate change, appealing to fear can be a useful way of increasing risk perceptions, however communicating consequences that might be generally frightening but not perceived as personally relevant (e.g., Nursing Directors reported being least concerned about water availability and malnutrition) can create feelings of indifference, powerlessness, or cynicism (Maibach et al., 2008). Instead, communication should appeal to personal or local risks that cause people to feel specifically affected. Risk messages can use several different frames, including potential impacts on health, national security, or the economy to communicate about the importance of taking action against climate change. For example, messages about saving money through reduced water or energy consumption appeal to economic values, but could lead to more conservation-oriented behavior.

Knowledge gaps reported in this study have highlighted a need to communicate with decision-makers about both the predicted health impacts in specific jurisdictions and how to respond to the risks. More than just providing knowledge, however, messages about health impacts should be developed that will increase the individual and agency sense of responsibility because a greater sense of responsibility made Nursing Directors more likely to feel positively about taking action, and perceived responsibility was found to be a considerable predictor of action-oriented attitudes. If Nursing Directors do not feel responsible for taking action against climate change as an environmental issue, responsibility could be increased by instead emphasizing the public health importance of addressing climate change. Maibach et al. (2010)

found that a majority of people reacted positively to a public health-framed essay about climate change even if they were openly skeptical about climate change; the findings were believed to be the result of giving individuals a more salient perspective on a largely misunderstood and contentious issue with somewhat ambiguous impacts. Framing climate change as a public health issue adds personal and societal relevance, particularly when focused on common health conditions like asthma or allergies, and may cause people to think at least somewhat more critically about climate change evidence over time (Maibach et al., 2010).

Leiserowitz (2006) and Slovic (2000) point out that many public opinion polls to date in the United States have focused only on distinguishing general concerns Americans feel about climate change. While this information is useful, both authors assert that such polls provide very limited insight into the various dimensions of risk, including the psychological and sociological factors that determine how individuals develop different perceptions and beliefs and arrive at given levels of concern (Leiserowitz, 2006; Slovic, 2000). Such insight is critical because it allows risk communicators to categorize audiences based on their similar beliefs, behavior, and motivations, and more effectively engage specific audiences with the most relevant messages rather than taking the largely ineffective “one size fits all” approach (Maibach et al., 2011).

Research like the kind that has been reported here is instrumental in providing risk communicators with important information about certain characteristics of their audiences and how messages should be specifically tailored to effectively resonate with individuals. In addition to an improved understanding of specific audiences, there is also a critical need for continued research on local impacts, improved education for both the public and policymakers, and a

greater focus on possible solutions and benefits of taking action to address health risks of climate change.

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APPENDIX A

Thank you for agreeing to take part in this study. Your input is crucial to the success of this project, and we appreciate the time you are taking. Your responses will be completely anonymous, but by viewing public reports and publications describing this research, people in the United States and elsewhere will have access to our findings. Your answers therefore are important and should be truthful and accurate. Keep in mind that there are no right or wrong answers to any of the questions; we are only interested in your opinions.

The survey consists of three parts, and will take approximately 20 minutes to complete. In Part I, we will ask you to state your opinions about the relationship between humans and the environment, climate change, the health-related impacts of climate change, and the role that Public Health may play in addressing climate change issues. In Part II, you will be asked a series of questions about oil and energy consumption, the concept of "Peak Oil", and the role of Public Health in energy consumption reduction activities. In Part III, you will be asked to respond to several questions that will help us learn more about you and your job responsibilities. Please be sure you complete all three parts so that we may include your results, grouped with others, in our analyses and reports.

Thank you again for your time and participation!

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Listed below are statements about the relationship between humans and the environment.

Please indicate to what extent you agree or disagree with each statement
(where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)).

	SD			N			SA
	-3	-2	-1	0	1	2	3
We are approaching the limit of the number of people the earth can support.	○	○	○	○	○	○	○
Humans have the right to modify the natural environment to suit their needs.	○	○	○	○	○	○	○
When humans interfere with nature it often produces disastrous consequences.	○	○	○	○	○	○	○
The earth has plenty of natural resources if we just learn how to develop them.	○	○	○	○	○	○	○
Plants and animals have as much right as humans to exist.	○	○	○	○	○	○	○
The balance of nature is strong enough to cope with the impacts of modern industrial nations.	○	○	○	○	○	○	○
Humans are severely abusing the environment.	○	○	○	○	○	○	○
Humans will eventually learn enough about how nature works to be able to control it.	○	○	○	○	○	○	○

This next set of questions has to do with your opinions about climate change. Please read each question carefully and check the appropriate response that best represents your opinion.

To begin, people sometimes disagree about how the climate system works. The five pictures below illustrate five different perspectives, using the analogy of a ball balanced on a line, to represent the climate system. Each picture depicts different perspectives about the ability of the climate system to withstand disturbances. Which one of the five statements and corresponding images below best represents your understanding of how the climate system works?

- ◯ A) Climate is stable within certain limits. If the changes are small, climate will return to equilibrium. If they are large, there will be abrupt and catastrophic impacts.
- ◯ B) Climate is random. We do not know what will happen.
- ◯ C) Climate is slow to change. Climate change will gradually lead to dangerous impacts.
- ◯ D) Climate shows a delicate balance. Small changes will have abrupt and catastrophic impacts.
- ◯ E) Climate is very stable. Climate change will have little to no impact.

Please indicate to what extent you agree or disagree (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)) **that your jurisdiction:**

	SD -3	-2	-1	N 0	1	2	SA 3
Has experienced climate change in the past 20 years.	◯	◯	◯	◯	◯	◯	◯
Will experience climate change in the next 20 years.	◯	◯	◯	◯	◯	◯	◯

Scientific consensus indicates that climate is changing. Please indicate the number that best represents where your opinion of the cause of climate change falls on this scale from completely natural to completely human.

Completely natural		Balance of natural and human		Completely human
◯	◯	◯	◯	◯
1	2	3	4	5

Please indicate to what extent you feel climate change is bad or good.

Bad			Neither bad nor good			Good
◯	◯	◯	◯	◯	◯	◯
-3	-2	-1	0	1	2	3

Please indicate to what extent you feel climate change is controllable or uncontrollable.

Controllable			Neither controllable nor uncontrollable			Uncontrollable
◯	◯	◯	◯	◯	◯	◯
-3	-2	-1	0	1	2	3

This next set of questions has to do with your opinions about the health-related impacts of climate change. Please read each question carefully and respond by either selecting or typing in the response that best represents your opinion.

Please indicate to what extent you feel addressing the potential health-related impacts of climate change through the public health system is bad or good.

Bad			Neither bad nor good			Good
○	○	○	○	○	○	○
-3	-2	-1	0	1	2	3

Please indicate to what extent you feel addressing the potential health-related impacts of climate change through the public health system is worthless or valuable.

Worthless			Neither worthless nor valuable			Valuable
○	○	○	○	○	○	○
-3	-2	-1	0	1	2	3

On a scale of 0-10, 0 being no knowledge at all, and 10 being knowing everything there is to know, what would you say is your level of knowledge about the potential health-related impacts of climate change in your jurisdiction?

Using the same scale of 0-10, where do you think your knowledge *should be* about the potential health-related impacts of climate change in your jurisdiction in order to plan appropriately?

For the remaining questions in this section, please indicate to what extent you agree or disagree with each statement **(where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)).**

	SD			N			SA
	-3	-2	-1	0	1	2	3
I am concerned about the health-related impacts of climate change in my jurisdiction.	○	○	○	○	○	○	○
In the next 20 years, the health-related impacts of climate change will be serious in my jurisdiction.	○	○	○	○	○	○	○
In the next 20 years, the health-related impacts of climate change will be serious in the United States.	○	○	○	○	○	○	○
In the next 20 years, the health-related impacts of climate change will be serious around the world.	○	○	○	○	○	○	○
In my position, it is expected that I seek information about the potential health-related impacts of climate change.	○	○	○	○	○	○	○
I am easily able to locate information on the potential health-related impacts of climate change.	○	○	○	○	○	○	○

The following set of questions asks your opinions on the role of environmental health departments in addressing the health-related impacts of climate change.

Please read each question carefully and respond by indicating to what extent you agree or disagree with each statement (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)). **Keep in mind that when we refer to your department, we mean your environmental health department.**

	SD			N			SA
	-3	-2	-1	0	1	2	3
My environmental health department has a responsibility to address the health-related impacts of climate change.	○	○	○	○	○	○	○
My environmental health department has the ability to address the health-related impacts of climate change.	○	○	○	○	○	○	○
My environmental health department's actions can decrease the health-related impacts of climate change in my jurisdiction.	○	○	○	○	○	○	○
My environmental health department is prepared to address the health-related impacts of climate change.	○	○	○	○	○	○	○
Addressing the public health consequences of climate change is a priority in my environmental health department.	○	○	○	○	○	○	○

The following are a list of health-related impacts that may increase as a result of climate change. Please think about whether each of these issues:

A. has already increased or will increase within the next 20 years as a result of climate change, and
B. is currently, or soon will be, an area of programmatic activity in your EH department.

Now, please select the choice that most appropriately represents your understanding of the following health-related impacts across the previously mentioned categories. Please check yes, no, or don't know (DK) for each of columns A and B.

	A. Has already increased or will increase within the next 20 years as a result of climate change.			B. Is currently, or soon will be, an area of programmatic activity in your EH department.		
	Yes	No	DK	Yes	No	DK
Heat-related illness	○	○	○	○	○	○
Flooding-related displacement of residents	○	○	○	○	○	○
Vectorborne infectious disease	○	○	○	○	○	○
Waterborne disease	○	○	○	○	○	○
Foodborne disease	○	○	○	○	○	○
Water availability related illness	○	○	○	○	○	○
Air quality related illness	○	○	○	○	○	○
Malnutrition	○	○	○	○	○	○
Disruption of health care services during extreme weather events	○	○	○	○	○	○
Anxiety, depression or other mental health conditions	○	○	○	○	○	○
Cold-related illness	○	○	○	○	○	○
Other climate change-related health impacts in your jurisdiction	○	○	○	○	○	○

If you checked yes **for "Other climate change-related health impacts..." please list those issues below.**

Please list the three most important resources that your department needs in order to improve your ability to address the health-related impacts of climate change. These resources could be, but are not limited to: staff, staff training, equipment, funding. Please provide as much detail as possible (e.g., What type of staff? How much money? What type of training?)

This concludes the first part of the survey on climate change and related health impacts. Is there anything else that would help us understand how your department is currently engaged in addressing the health-related impacts of climate change, or what your department might need in the future to engage in these activities?